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Chapter XI

Environmental Control Aboard Ship

A BACKGROUND TO ENVIRONMENTAL SANITATION

ENVIRONMENTAL CONTROLS deal with the complex of climatic, family, physical, and biological factors that act on an individual, his community, and his natural or man-made surroundings. These controls ultimately determine his health and survival.

The seaman's health and survival depend mainly on three related controls:

- (1) His own efforts to maintain his physical and mental efficiency at an optimum level;
- (2) The organization of the physical facilities and the supplies necessary to maintain him in a state of maximum efficiency, and
- (3) The efforts of other personnel, ashore and afloat, to create and maintain conditions intended to promote the seaman's good health.

The seaman should expect and find certain facilities, supplies, and healthful conditions in his shipboard environment. In turn, he and his fellow crew members have a major responsibility for the state of that environment. Individual and group health are totally dependent

on a proper give-and-take attitude among the crew.

A give-and-take attitude is particularly important in maintaining good environmental sanitation aboard ship. Proper sanitation is impossible unless each crew member cooperates. At the same time, the Master should ensure the good sanitary conditions of the vessel through periodic inspections by appropriate persons to whom he delegates this responsibility.

Proper ventilation, lighting, food sanitation, liquid transport, waste disposal, personal hygiene, ship inspection, and the management of disease vectors (carriers) will be discussed in this chapter.

VENTILATION

Ships are compartmentalized to keep them buoyant and watertight. This makes proper ventilation difficult. Various methods of air conditioning, exhausting, and forced ventilation have been tried. Modern vessels use ventilation and forced air to create conditions most suitable for working in ships' compartments.

For effective ventilation there must be an adequate flow of clean air with sufficient oxygen content; controlled humidity to prevent "sweating," mold, and allergic reactions; and controlled temperatures to make the air comfortable.

The design and operation of the ventilation system should assure that air is provided to all living spaces as required for personnel and equipment safety. Air should not be recirculated from any exhaust system without adequate filtration to remove bacteria, foreign bodies, toxic gases, odors, smoke, and other hazards or annoyances. All ducts should be located where they are accessible to inspection, maintenance and repair, and filters should be placed properly, cleaned, and inspected on a regular basis. Ventilation rates and temperature criteria should conform to the directives issued by the Naval Sea Systems Command, U.S. Department of the Navy.

Microorganisms

One of the dangers of a faulty ventilation system is the transmission of diseases caused by microorganisms, although airborne infections usually are of minor importance except for certain respiratory diseases of bacterial and viral origin.

Because of the limited living space aboard some vessels and the possibility of the ventilation system recycling air through the vessel, the entire crew can be infected with virulent organisms. To prevent this, controls should be used. Two control methods are disinfection of the air by ultraviolet light and filtration of the air by mechanical or electrostatic means. Each method has its drawbacks. It is the responsibility of the Chief Engineer to use one or more of these mechanisms when there is a danger of airborne infections being circulated through the ventilation system of the ship.

Gases

Besides bacterial contamination of air, a common hazard aboard ship is the accumulation of gases in holds, bunkers, paint lockers, tanks and other confined areas. Such gases may be toxic (poisonous) or they may displace oxygen. Seamen entering such an enclosed space may become ill or die of asphyxia (suffocation).

Among commonly found toxic gases are carbon monoxide, carbon dioxide, ammonia, chlorine, nitrogen, and petroleum gases. These gases and others are found in varying combinations in shipboard fires; in empty oil, chemical, and storage tanks; and in the bilges, skin tanks, and certain cargo holds. Certain classes of cargo absorb oxygen or give off toxic gases. This is particularly true of products of plant origin such as linseed cakes, resin, and tobacco.

Poisonous gases or fumes may be formed in chemical, petroleum or whale-oil tanks as a result of decomposition of residues remaining after the tanks are emptied. Fumes can develop from cargoes of hides that have become moist and have fermented. Enclosed freshly-painted compartments can be lethal if not properly ventilated. Also dangerous are ships' tanks which have been painted.

Mechanical refrigeration systems are potentially dangerous due to leakage of ammonia, Freon,[®] or other refrigerants into enclosed spaces. Cyanide or other gases that are used to fumigate ships present a serious hazard, during and after fumigation until properly aired.

In all cases, safety rests with proper ventilation and proper individual precautions. It is the responsibility of the Deck Officer and/or Chief Engineer to assure that when compartments or tanks must be entered or cleaned that the area has been ventilated thoroughly, all explosive gases have been vented, and the oxygen supply is adequate. Also, the responsible officer should make sure that the first person entering the area wears a lifeline so that he can be retrieved if he becomes faint or ill. The work crew should be checked continuously during the first half hour of work. Proper oxygen canister-type gas masks and someone who knows how to use them should be available, if a rescue becomes necessary.

These precautions should be reinforced by frequent training demonstrations and emergency drills for all ship's personnel on the use of rescue and mask equipment. For reference, every ship's officer should have in his possession a copy of "Gas Hazards on Shipboard," by Alan Osbourne, *Modern Marine Engineer's Manual*, Vol. 1. A Bayne Meild, Jr., editor. Cambridge, Maryland: Cornell Maritime Press, Inc., 1965.

LIGHTING

Adequate lighting aboard ship is essential for efficiency and safety. Fatigue and eyestrain develop rapidly in poor illumination. Work performance is reduced, accidents increase, and consciously or unconsciously the individual's morale deteriorates.

The amount of light needed varies with the type of work or activity being performed. For instance, less light is needed for eating, resting, or general recreation than for reading, plotting charts, or carrying out other detailed work.

Good lighting is important especially in the engine room, galley, chartroom, and companion ways. In the engine room, high illumination free from glare is desirable. Lights should be located so that crew members will cast the fewest possible body shadows upon their work, and equipment will not create pools of darkness.

The light focused on a work surface is *local light*, as distinguished from the *general illumination* of a compartment. The amount of general illumination should be at least one-tenth that of the local light because it is difficult for the eyes to adjust back and forth from a brightly lighted work surface to a dimly lighted compartment.

The relationship of lighting to safety in the engine room, companion ways, and ladder wells is obvious. Good visibility in the galley, pantry, scullery, and head also is necessary. Adequate illumination in the food service and preparation areas is essential to proper food handling and to maintain adequate sanitation standards.

Proper lighting depends on such factors as brightness, location, and color of the light sources; size, shape, color, and contents of the area being lighted; and texture of the surfaces. The most important and readily adjusted of these factors are brightness and location of the source. The amount of light can be controlled by varying the distance to the source, its brightness (by wattage, shape, size, color, clarity, or frosting), and the use of shades, mirrors and reflectors. The surface on which the light falls can be changed to improve visibility.

The energy source should be located so that adequate light hits the work area, but does not shine into the eyes or create glare. Glare pro-

duces temporary blindness and fatigue, which might lead to accidents.

The Chief Engineer must see that lighting is adequate for the work to be done and that dangerous reflection, glare, and shadows are eliminated. To further eliminate danger to seamen, he must see that light sources are shielded and are immediately replaced when they fail.

FOOD SANITATION

Food procurement, preparation, and services aboard most vessels are the primary responsibility of the Steward's department. The galley crew and others in the department are responsible for the cleanliness of food preparation and storage areas, as well as for the sanitary manner in which food is served in the mess areas and dining saloons.

It is the responsibility of the Master and the Chief Steward to monitor the health of the food handlers; and to make regular and unscheduled inspections of areas used for the storage, preparation, and service of food, as well as self-dispensing food service units aboard ship.

The proper care of a ship's food services and supplies involves the handlers of food; the conditions of purchase; surroundings in which food is stored, prepared, and served; the care of the utensils and utilities; the disposal of food wastes; and the control of vectors of disease, as insects and rodents.

The Food Handler

Aboard a merchant vessel, the food handler should be a member of the Steward's department and directly responsible to the Chief Steward for overall direction.

Requirements for the examination of the food handler are listed in current publications of the U.S. Coast Guard, U.S. Public Health Service, State and local health agencies, and many ship companies.

A food handler should have a thorough physical examination at least once a year, and inspections for communicable diseases at more frequent intervals. Physical examinations for food service personnel are provided in major ports by the medical departments of the oper-

ating company; city health departments; and other facilities designated by the company, the union, or the country.

A carrier of typhoid or other communicable disease should not be permitted to prepare or handle food. Crew members with skin infections or open wounds should not handle food, eating utensils, or dishes that will be used by others.

It is the responsibility of the Purser, Chief Steward, and Chief Cook to assure that any food handler signed aboard has proper health certification. Pierhead jumpers and others who may sign on without proper examinations should never be assigned duty in the Steward's department until each has passed a complete and thorough medical examination.

The food handler should be trained for his job and impressed with the critical importance of helping to reduce the potential for communicable diseases among the crew. He must be scrupulous in the cleanliness of his body and clothing. The food handler must wear clothing designed for food service areas, and this clothing should be laundered regularly and worn only during working hours.

To encourage high standards of personal hygiene among food service workers, the "head," with its toilet and lavatory facilities, must be readily accessible to the food preparation area. Hand washing facilities, with sanitary soap dispensers and individual towels, should be available in the food preparation area. It is the Chief Cook's responsibility to see that the facilities are utilized.

Food Service Facilities

All food service facilities aboard ship should conform to the minimum requirements in the U.S. Public Health Service's publications: *Handbook on Sanitation of Vessel Construction*,* Public Health Service Publication No. 393, 1967; and *Handbook on Sanitation of Vessels in Operation*, Public Health Service Publication No. 68, 1963.

In general, surfaces of all decks, bulkheads, and deckheads in the food processing, serving, and storage areas should be corrosion-free, smooth, and easy to clean. All surface materials

coming into contact with foods should be corrosion-resistant, non-toxic, nonabsorbent, smooth, durable, and easy to clean.

Utensils and Equipment

Cooking utensils and equipment must be made of materials that are non-toxic; that is, they should not be made of metals such as cadmium, lead, zinc, or antimony. The positioning of this equipment and storage of utensils should be planned for safe, efficient use. Each item should be designed, constructed, and installed to permit ease of cleaning, disassembling, and maintenance. All permanently installed or stationary equipment should be constructed so that flashing or closing strips will exclude openings to adjacent structures or other equipment, unless adequate clearance for proper cleaning is provided.

Commissary equipment to be purchased on the open market, such as dishwashing machines, food mixers, ranges, and other food handling, preparation or storage equipment, should be procured only if judged acceptable by the U.S. Public Health Service. Such acceptance is based on a careful review and evaluation of the equipment and its component parts and materials, to assure freedom from undesirable sanitation features, ability to perform its sanitary function satisfactorily, and its ease of cleaning.

Proper plumbing equipment in the food service areas is mandatory. Potable water only should be piped into food service spaces, except that non-potable water may be piped to garbage grinder eductors. Food service equipment and spaces should be adequately drained, and the drains should be protected from backflow of wastes.

The Chief Steward and the Chief Engineer must assure that the foregoing recommendations are implemented, and make regular sanitary inspections to see that no health hazards develop.

Food Storage

Non-refrigerated Items

The non-refrigerated foods can be divided into *bulk items* and *broken or lot items*. The bulk items are boxed, bagged, or canned. While

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each has specific storage needs, all have certain common requirements such as a storage area that can be locked and separated from non-food items. Bulk items must be kept free of dampness, condensation or waste waters, and free of poisons and contaminants. They should be stored in a protected, cool, dry area; rotated regularly, and kept free of rodent and insect contamination. If such food becomes infected or outdated, it must be destroyed.

Once foods are removed from the dry stores storeroom and dispensed to the day stores, they must be protected from contamination after the original protective packaging is removed.

Bulk foods must be stored so that access for inspection is provided. They also must be stored to be readily accessible for use and secured so the ship's roll will not allow rupture, shift, or drift. The foods must be kept clear of all cleaning or chemical agents. Supplies should not be stored directly on the deck but should be elevated at least six inches to facilitate cleaning and to reduce insect and rodent harborage.

After loading aboard ship, storage requirements for *boxed foods* demand that they be utilized quickly to minimize vermin infestation. They must be dated for proper utilization and never left in storage in an opened state.

Non-refrigerated *bulk items* such as cereals, beans and sugar, as well as vegetables such as potatoes and onions, are extremely susceptible to external contamination, insect and rodent infestation, and rupture. They must be protected by storage in easily-cleaned vermin-proof containers or bins.

Non-refrigerated *canned or bottled items* usually are stored in boxes or crates. They are best protected by maintaining a rotating inventory, keeping the units dry and preferably cool, and eliminating damaged or distorted cans or tins. Corrugated paper boxes should be emptied and removed from the ship as soon as possible, as they are apt to harbor insects. Some items, such as pickled goods, are stored in barrels or hogsheads, casks or kegs and are best kept in cool areas.

By observing these controls, non-refrigerated foodstuffs can be stored so that the health of the crew and passengers is protected.

The Chief Steward must assure the quality and safety of stored non-refrigerated food stuffs.

Refrigerated Items

The same basic requirements apply to the storage of refrigerated items. However, refrigerated storage is more confined, and specified temperatures must be maintained.

Refrigerated foods fall into two general groups—*frozen foods* and *cooled foods*.

Frozen foods must be kept at 0°F to -10°F (-18°C to -23.2°C) from time of freezing until time of preparation. Under these conditions, food retains normal taste and appearance and has a shelf life from one to six months. Once thawed, however, such food must be used immediately and not refrozen under any circumstances. Once food is thawed, it rapidly deteriorates and may become toxic due to bacterial action. For best utilization, frozen food is stored in packaged units. Once a package is opened, the contents must be wrapped, kept frozen in the day stores, and used at the earliest opportunity.

Cooled food items kept in storage most often are fresh fruits and vegetables, processed and cooked meat products, and foods prepared for rapid utilization. These, as well as leftovers, should be kept covered and stored at from 32°F to 45°F (0°C to 7.2°C) depending on the product.

Both the freezer and cooler compartments should have highly accurate, adjustable thermostats for temperature control. Thermometers should be easily visible to persons working in passageways serving the refrigerated spaces and on the Engineer's control panel.

In cooled food storage areas, humidity ranges from moderate to high. Cooled foods, properly handled, have a storage life of from one day to four months, depending on the item. Leftover food should be assumed to have a shelf life of not more than 48 hours because of the possibility of contamination. At 40°F (4.4°C) and below, this danger is minimized.

Both frozen and cooled foods keep better when the refrigeration unit is properly drained, kept clean, and free of ice, frost, food spillage or residue, fungus, and slime. For

freezer efficiency, remove frost or ice before it reaches one-quarter inch in thickness.

When defrosting, wash the freezer with steam or heavily chlorinated warm soapy water to remove slime, dirt, grease and fungus growth. Shelves, hooks and grids should be removed and washed with a warm detergent solution, then steamed down, rinsed in hot water and, if possible, sun dried or heat dried. The refrigerator decks should be cleaned and scrubbed with a hot detergent solution and then rinsed. The drains should discharge preferably into a separate drainage system or into a separate vented tank—*never into the plumbing system or open bilge*. When the refrigerator empties into a sewerage or drainage system, there must be an air gap between the refrigerator drain and the system.

After cleaning, the refrigerator should be loaded so that stores are placed neatly, with no physical overloading and separated to allow free circulation of air. Foods to be refrigerated should be stored in shallow metal pans or plastic containers covered with wax paper, plastic, or aluminum foil.

The Chief Steward must assure the cleanliness of the storage areas and food storage equipment; and the Chief Engineer must assure the effective functioning of these units.

The Galley

It is most important that the general galley be constructed so that work spaces are clear and the decks are covered with waterproof, non-slipping surfaces. Also, the galley should be equipped, illuminated, and maintained to assure good sanitation. Equipment should be made of corrosion-resistant, non-toxic materials that are easy to clean. All galley areas, especially the cooking areas, should be fire-protected, easy to clean, and capable of being rapidly vented of smoke, steam, odors, and gases. (See Fig. 11-1.) Proper ventilation will keep the galley dry and pleasant.

All galley water must be potable, except nonpotable water may be piped to the garbage grinder eductor. Back-siphonage must be prevented. All drains must be trapped and should have easily accessible "clean outs."

Waste, particularly food scraps, should be kept in tightly covered sturdy garbage cans.

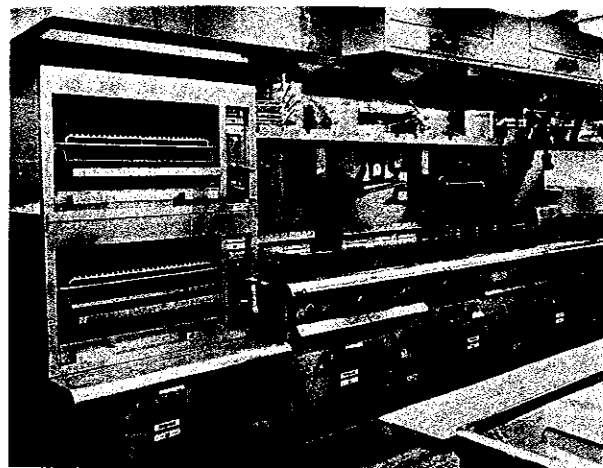


Fig. 11-1. Cooking area of main galley.

Where possible, these should be stored in refrigerated areas until the garbage can be disposed of properly.

Pipes carrying nonpotable liquids, as drains and overboard water, should be kept to a minimum in the areas used for the storage, preparation, and serving of food.

It is the Master's duty to work with the Chief Steward to ensure the sanitary and safety conditions of the galley areas.

Where possible, all galley equipment and utensils should be fixed in place. Non-fixed utensils should be hung or stored to avoid loss, damage, or injury to seamen when the ship rolls.

Foodstuffs, supplies, cookware, crockery and utensils should be thoroughly cleaned after each use and stored in containers that can be secured when the items are not in use.

LIQUID TRANSPORT

Ship's Liquid Transport Systems

Specialized piping systems on ships include the *bilge system* which collects drainage that must be pumped overboard; the *clean ballast system* which maintains the proper trim, stability, and immersion of the vessel; and the *fuel oil and oily ballast* which stores and transfers clean oil to the ship's fuel system, and secondarily replaces the oil with sea water as part of the ballast system.

Other specialized piping systems are the *fire system* which supplies water under pres-

sure to the ship's fire stations and to the deck and anchor wash areas; the *sanitary system* which supplies water to the heads and other sanitary fixtures; and the *wash water system* which supplies fresh water from skin and/or peak tanks. *The wash water system must be independent of all other piping systems and labeled: not fit to drink.*

An important specialized piping system is the *drinking water system* that supplies potable water to fountains, washing, and culinary units. The drinking water system must be protected as well as isolated from all other systems, and its water must conform to the *National Interim Primary Drinking Water Regulations*, effective June 24, 1977. These regulations are under the jurisdiction of the Office of Water Supply, U.S. Environmental Protection Agency (EPA), 401 M Street, S.W., Washington, D.C. 20460. For further information, contact the EPA.

Miscellaneous systems aboard ships include transport steam, compressed air, foam, and numerous other specialized liquid and gaseous agents.

Potable Water Sources

The handling of water must be rigidly controlled from source to consumer to avoid contamination.

Potable water on shipboard is derived either from distillation or from natural sources. Distilled water is either fresh or salt water that has been converted to steam and back to water. It is relatively free of impurities but has a flat taste. Natural water, or "shore water," usually is obtained from wells, springs, or fresh water bodies ashore. Usually it must be treated, either ashore or afloat, to protect the health of the seaman.

Potable Water Transport Systems

The water system of a port city is the usual source of potable water. It is made available to the ship either through watering points at dockside or from water boats.

The Master must determine if a water source is safe by consulting either his local company agent or the local public health department. In the United States, this can be

determined from the current OFFICIAL CLASSIFICATION OF VESSEL WATERING POINTS,* (unnumbered publication), 1976.

Each vessel currently is required to carry sufficient potable water hose to load its potable water. This special hose is kept in a storage cabinet labeled "*Potable Water Hose Only*," and it is not to be used for any other purpose. (See Fig 11-2.)

A Deck Officer is responsible for the cleanliness and safety of his ship's filling hose and its ends, as well as the connections of dockside, water boat, or shipside filling lines. These connections—outlet and inlet—must be at least 18 inches above the dock, water boat deck, and ship's deck, and housed with a proper fitting. Each such watering point connection must be labeled "*Potable Water Filling*."

Potable Water Storage

To avoid contamination, potable water tanks should have no common partition with

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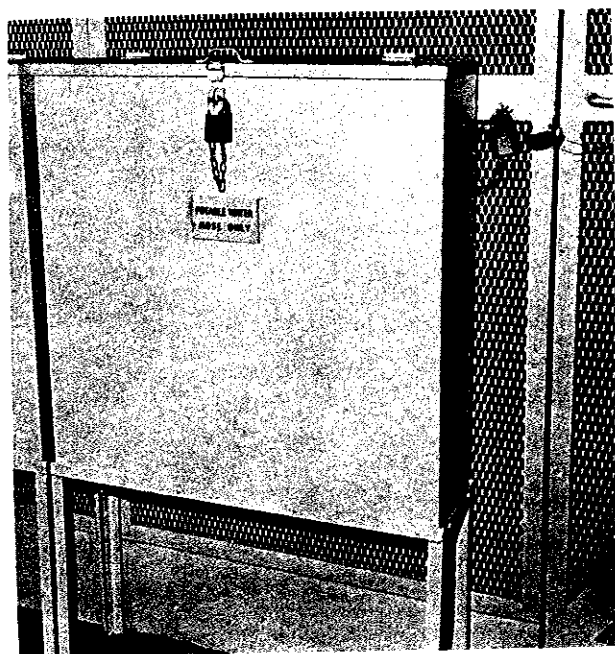


Fig. 11-2. Storage cabinet clearly marked for special hose used only for potable water.

tanks containing nonpotable liquids—including skin tanks—unless the water is to receive additional treatment by a method approved by the U.S. Public Health Service, the World Health Organization, or the government registering the vessel. No “head” may be constructed over that part of the deck which forms the top of the water storage tank, and no non-gravity tunnel may pass through it. The tank must be labeled “Potable Water” and be accessible through a watertight, preferably side-mounted, manhole. It must have an overflow and relief valve or vent, be drainable completely from a bottom drain, able to withstand pressure, and have water level gauges or petcocks.

Potable Water Pipelines and Service Units

Potable water should be transported from the storage areas to dispensing units through identified (i.e., color-coded non-cross-connected pipes made of safe metals or plastic). All potable water outlets must be protected from back-siphonage by an air-gap or approved vacuum breaker. Drinking fountains should be constructed so the mouth of the seaman does not have to touch the spout, and the fountains should be fitted with splash guards.

Disinfection of Potable Water Systems

Historically, waterborne diseases have been the most common cause of disability and death among seamen. Among such diseases are dysentery, cholera, typhoid, hepatitis, poliomyelitis, amebiasis, and schistosomiasis.

Waterborne diseases would be a constant threat if not held in check by the sanitary control of fresh water supplies. Drinking water must be obtained, transported, and stored under protected conditions.

Potable water tanks, which must have a suitable inner lining that meets U.S. Public Health Service standards, should be cleaned and sanitized at least once a year.

The system should be filled with water and superchlorinated with hypochlorite (50 ppm). To be effective this solution should remain in the system for four hours, after which the tank should be flushed and refilled with potable water.

LIQUID AND SOLID WASTE DISPOSAL

Liquid wastes are organic materials that can be moved in a liquid. These include body excretions such as feces, urine, sputum, and vomitus; sink, laundry and washroom wastes; food, tank, bilge, and engine room wastes; and other degradable materials. Aided by flushing from the sanitary water system, these wastes are mixed with water and carried out of the vessel by its waste pipes and/or scuppers.

Solid wastes are any discarded materials which are not readily degradable without heat or pressure. Aboard ship, these include discarded items such as surgical dressings, disposable unit containers, and refuse.

Both liquid and solid wastes are health hazards. Contamination by these wastes can cause outbreaks of typhoid fever, paratyphoid fever, cholera, or dysentery. Rats, flies and other vectors of disease thrive on solid wastes. Consequently, waste disposal from vessels must be accomplished without endangering the lives of persons aboard the vessel or in off-ship areas.

Throughout the developed world and much of the developing world, it is illegal to discharge sewage, bilge water, ballast, or solid waste near public water supply intakes; or in any other areas restricted by national, State or local laws, regulations or codes. In the United States these restrictions can be obtained from any Regional Office of the U.S. Department of Health and Human Services, the U.S. Coast Guard, the U.S. Environmental Protection Agency, and the U.S. National Oceanic and Atmospheric Administration.

As a further safeguard, the Master should consult with local authorities before the vessel discharges wastes in possibly restricted areas, because each locality and country has regulations which are highly individual.

CONTROL OF DISEASE VECTORS

Throughout maritime history, ships' crews and inhabitants of ports have been decimated and incapacitated by vector-borne diseases. Rats, mice, and monkeys carry disease. Parrots and parakeets are common bird vectors, and common insect disease carriers include mos-

quitoes, flies, bedbugs, lice, ticks, and cockroaches.

Control of vectors aboard ship is the responsibility of the Master and those persons he designates. Control of vector entry into, and exit from the port is primarily the responsibility of U.S. Public Health Service and port authorities.

The shipping company, through the Master, also has a major responsibility for the cleanliness of the ship. Hospitalization or return home of sick seamen is a major cost under the "maintenance and cure" clause of maritime law. In extreme circumstances, quarantine of an infected or infested vessel has been known to have caused a loss to the company of a quarter of a year's income, while acquiring new clearance papers.

While it is the Master's responsibility to keep his ship clean and free of vectors of disease, he also must see that an officer, such as the First Mate or Marine Physician Assistant, maintains a ship's medical log of: (1) all diseases and illnesses of the crew and passengers; (2) quarantine declarations, deratinization or exemption certificates, and passenger and crew lists (with their immigration, vaccination, and inoculation histories), and (3) other special declarations required by the country, port, or agency.

Control of Rodents

Rats on a ship are a health menace and a nuisance. They cause extensive damage to cargo and food, and rat droppings contain organisms which produce intestinal diseases. Because rats usually attempt to forage in the galley and provision storeroom areas, these organisms are likely to be introduced into the food supplies. Rats carry fleas which may transmit plague and murine typhus. Because of these dangers, ships heavily infested with rats must be fumigated, and fumigation is a laborious, expensive, and dangerous procedure. It can be avoided through adequate rat-control measures.

Despite reasonable precautions by the ship's personnel and port authorities, some rats may be aboard. However, infestation can be avoided by *not* providing food and nesting places for rats, and by trapping or otherwise

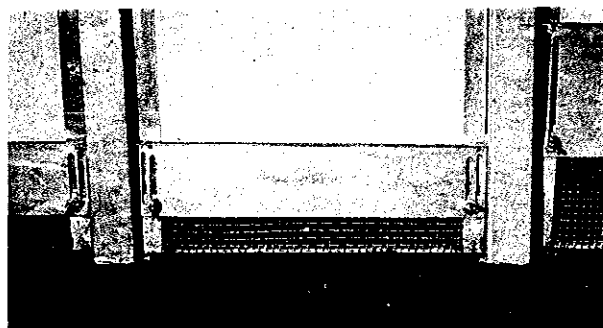


Fig. 11-3. Ratproofing of bulkhead.

destroying them before they breed and develop colonies.

Frequent inspection of a ship for signs of rat life (trails or runs marked by dirt or droppings) will indicate the kind of measures that should be taken to prevent rat infestation. There are four general measures available:

- (1) keeping the rats from getting aboard;
- (2) ratproofing the ship, thus "building out" the rats by elimination of their living places or harborages (see Fig. 11-3);
- (3) keeping all food protected and avoiding accumulation of food scraps, thus "starving out" the rodents; and
- (4) killing them by trapping, poisoning, or expert fumigation by personnel from authorized agencies.

All chemicals (rodenticides and insecticides), that are used to control vectors, should be kept in their original containers, properly labeled and securely stored away from food (stores and cargo).

To prevent rats from coming aboard, every available precaution should be taken. This includes proper placement and maintenance of rat guards on all mooring lines and keeping the gangplank well illuminated.

Ratproof construction is built into most modern ships. The increased construction cost of ratproofing is more than repaid by preventing damage to cargo and avoiding excessive fumigation and other quarantine delays.

Ratproofing includes the elimination of hidden spaces and dead spaces for rat harborages. If such spaces cannot be eliminated, they should be constructed in a manner that makes the entry of rats impossible. The ship must be

kept in good repair if ratproofing is to be continuously effective. Lockers, boxes, dunnage, or other movable equipment not part of the ship's original structure should not be permitted to serve as temporary shelters for rodents.

Starving the rats must accompany ratproofing. All food and garbage should be stored in metal containers with tightly fitting metal covers. Nothing edible should be left exposed. Food or edible waste spilled accidentally in any part of the ship should be cleaned up promptly. These measures will help to control flies and cockroaches as well as rats and mice.

Trapping is a good method of keeping down the rat population. Snap traps, which are more effective and practicable than the cage type, should be set along ledges, bulkheads, and other places used as rat runs. Meat, bacon rind, or cheese may be used as bait for the traps if the rats cannot get at these foods in any other place. Apples, pears, dates, potatoes, and turnips also make good bait. The bait trigger should be pointed toward the bulkhead or rat run. The rat should be given the chance to nibble at the bait for the first few days before the trap is set. After a rat is caught, the trap should *not* be flamed or scalded; the odor of the rat will help in catching others. One should vary the kind of bait. Precautions should be taken to avoid touching the dead rat because of the danger of infected fleas.

Red squill, zinc phosphide, and the anticoagulants are the rodenticides (rat poisons) generally recommended by health departments for use by the public. These rodenticides are available commercially and are ones which the untrained individual is least likely to experience difficulties in handling.

The anticoagulant rodenticides, such as warfarin and diphacinone, kill in a radically different manner from the older acute (single dose) poisons such as zinc phosphide. They must be ingested for several consecutive days before they become effective.

Although it is extremely costly, a badly infested ship may be treated best by fumigation. The decision to fumigate a ship will depend upon the estimated number of rats aboard, the type of cargo, and the history of the voyage. For example, fumigation may be necessary, if a ship recently has touched a plague port.

The gases most commonly used for ship fumigation are hydrogen cyanide and methyl bromide. *These are extremely poisonous to human beings as well as to insects and rodents.* Therefore, fumigation must be carried out by experts.

Before fumigation is begun, the ship must be tied up at a distance from other vessels. It is absolutely necessary to make sure there is *no one on board* except those authorized to do the fumigating.

The ship to be fumigated must be cleared of all excess gear and dunnage. Drawers and lockers must be open for proper penetration and action of the gas. Ports, ventilators, and other openings must be secured to prevent the escape of gas.

After fumigation, the holds and superstructures must be aired. Tests must be made for the gas, after about an hour of airing. Beds and clothing must be thoroughly aired on deck for at least two hours because the gas has a strong tendency to remain in clothing and bedding. *Men have died as a result of returning too soon to compartments not completely aired and free of gas. A fumigated ship should not be boarded until released by the fumigating officer.* Also, any food that had been exposed to the gaseous fumigant must be discarded.

Control of Insects

Even with present control measures it is impossible to keep a ship completely free of insects. This is because of the variety of insects, their many methods of gaining access to the ship, and their ability to survive despite efforts to destroy them. Flies and mosquitoes may board the vessel at wharves or in harbors. Bedbugs, fleas, lice, and ticks may be brought aboard on the bodies, clothing, or personal gear of crew or passengers. Fleas also may be carried aboard by rats. Cockroaches and weevils may be present in provisions or cargo brought aboard the ship.

Insects transmit disease when germs on their bodies come in contact with food or other articles. Insects also may pick up and pass on disease by biting. For example, *Anopheles* mosquitoes transmit malaria, lice transmit epidemic typhus, and fleas transmit plague.

Suppression of insect infestation aboard ship demands coordination by ship and shore

personnel. Unless control is continued at sea, the most thorough campaign to destroy insects and rodents on a ship in port will not pay off. It is easier and less costly to maintain controls constantly, rather than to apply sporadic intensive measures only in port. Furthermore, living and working conditions will be better at all times.

To fight insects successfully, one must first know the habits of each type and apply this knowledge. For example, *body lice* live on the human body and clothing; therefore, personal cleanliness will go a long way toward preventing louse infestation. *Bedbugs* are most likely to seek shelter in mattresses and cracks around beds; thus cleanliness and frequent inspection are valuable control measures. *Cockroaches* breed prolifically in areas where food is available; therefore, strict cleanliness in areas where food is stored, prepared, or eaten is of great importance. *Flies* are attracted by unprotected food and refuse; hence, they can be curbed if exposure of food is kept at a minimum, and if refuse is placed in clean, tightly covered cans for prompt disposal.

Personal and environmental cleanliness are the most satisfactory elements of long-range insect control. Insecticides are useful in providing immediate, although temporary, relief from a heavy insect infestation. The sporadic or casual use of insecticides is of little value if the underlying conditions persist, because the insecticide's effects wear off, and the surviving insects, new generations and newly-introduced insects rapidly recreate the infestation. For best results, insecticides should be used only as a supplement to cleanliness and other permanent control measures.

Insect control operations present hazards through contact with poisons, machinery, and flammable materials. The safest effective pesticide should be used, and personnel should be aware constantly of the special hazards. Only properly trained, responsible personnel should be allowed to do insect control work. *Personnel should work in pairs, never alone.* Bystanders should be kept away, and chemicals and equipment should be under constant control to prevent their being stolen or picked up by accident. Regular maintenance and careful use of equipment are imperative.

Following are the insects most commonly found aboard ship, some of their characteristics, and suggested methods of control:

Flies

Domestic flies, some of which bite, may transmit enteric (intestinal) diseases to man. Their larvae and eggs may infest human flesh and intestines as well as stored foods.

Environmental Controls: Store all refuse in durable cans with tight lids and maintain insect screening.

Chemical Controls: Use residual and space sprays indoors and residual sprays outdoors.

Mosquitoes

Several species of mosquitoes suck blood and may transmit encephalitis, malaria, yellow fever, filariasis, and other diseases.

Environmental Controls: Eliminate standing water and maintain insect screening.

Chemical Controls: Use same measures as above for domestic flies.

Cockroaches

Roaches produce unpleasant odors, transmit diarrhea and dysentery, and damage food stores.

Environmental Controls: Eliminate cracks, crevices and dead spaces; store food and garbage properly; keep entire area scrupulously clean; watch for, and destroy, all cockroaches and their egg cases, particularly those introduced with luggage, food stores and furniture; remove corrugated cardboard boxes and cartons from provision storerooms as soon as feasible.

Chemical Controls: Spray cracks, crevices, baseboards, furniture, fixtures and cabinets with a pinstream spray of an appropriate insecticide, and dust an insecticide into dead spaces and on items which sprays might damage, such as power panels. Special precautions are required in food service areas.

Lice, Bedbugs, and Fleas

These ectoparasites which live on the outside of the body cause discomfort and may transmit disease.

Environmental Controls: Maintain personal hygiene by bathing and by laundering clothing and bedding frequently; keep cabins clean by vacuuming floors, rugs, and upholstered furniture weekly; watch for, and eliminate, ectoparasites introduced with luggage, clothing, bedding or furniture; eliminate cracks and crevices where they hide; avoid furniture with wood-to-wood joints and pillows or mattresses with rolled seams; eliminate rodents.

Chemical Controls: For *lice*, dust infested individuals and contacts with insecticide powders or materials prescribed by a physician. For *bedbugs*, spray cracks, crevices and furniture in infested dwellings with appropriate insecticides. Special attention should be given to the tufts and seams of mattresses. For *fleas*, dust infected areas and infested pets with an appropriate insecticide powder.

Pests in Stored Products

These pests (cockroaches, beetles, moths, ants, mites, silverfish, springtails) damage clothing and rugs and ruin many millions of dollars worth of stored foods annually. Also they produce or transmit human diseases.

Environmental Controls: Store foods and products in an orderly, sanitary manner in a cool, dry room on racks up off the floor; use old stocks first; inspect stocks regularly and dispose of any found to be infested.

Chemical Control: Spray storerooms with insecticide approved for use in food service areas, making sure none gets in or on stored food.

SANITARY INSPECTION OF A SHIP

The U.S. Public Health Service recommends that ships registered under the American flag carry a *Sanitary Log* (Form No. 9452), which can be obtained from any U.S. quarantine station. The purpose of this log is "... to provide quarantine officers, sanitary inspectors, ship's officers, agents, owners, and others with information regarding the sanitary history of vessels through systematically recorded reports of previous inspections ..."

In wartime and under various peacetime circumstances, a ship unexpectedly may change

its itinerary. It is difficult for government agencies to obtain a complete, accurate sanitary record of the vessel without such a log. If properly kept, the *Sanitary Log* should speed quarantine procedures.

All vessels arriving in the United States in ports of entry are subject to quarantine inspection by the Public Health Service of the U.S. Department of Health and Human Services. For detailed information see Appendix C, entitled *Regulations Governing Foreign Quarantine*.

Regular inspections are necessary to maintain a vessel in good sanitary condition. The persons making the inspections should be on the alert for signs of vermin and rodent infestation. Areas which should be inspected thoroughly include:

Forepeak	Sewage disposal
Provision storeroom	Washroom and head
Galley	Cold storage space
Pantry	Refrigeration space
Issue room	Mess space
Sickbay	Living spaces
Scullery	Shelter deck
Garbage disposal	Holds
	Brig spaces

PERSONAL HYGIENE

Hygienic living protects the health of the individual. The health of a seaman depends in part, on his own efforts to maintain habits of cleanliness and neatness.

Personal cleanliness includes good care of the skin, hair, nails, mouth and teeth, and proper maintenance of clothing, towels, and other personal gear. A daily bath or shower, particularly in hot weather or after working in hot compartments, is conducive to good health and lessens the possibility for infection of cuts or scratches. Brisk rubbing with a rough towel after a bath or shower stimulates circulation, promotes good skin tone, and gives a feeling of well being. Clean clothing should be put on following a bath or shower.

Care of the mouth and teeth by regular use of a toothbrush after meals and daily use of dental floss are essential to assist in the prevention of gum disease, infection, and tooth

decay. Before brushing natural teeth, any partial dentures should be removed and carefully cleaned with a brush and mild soap or special denture cleanser. Unclean removable dentures are particularly harmful to remaining natural teeth. Full artificial dentures should be cleaned regularly after meals, and particularly at bedtime, to remove food residue which can cause mouth odor and encourage infection.

The importance of washing hands at appropriate times cannot be overemphasized. Crew members should wash their hands before eating. Also, it is of vital importance, if cleanliness is to be maintained and the spread of infection reduced, that hands be washed immediately after urinating or defecating.

In cold weather, hands are less likely to chap if the skin is dried thoroughly. A little petroleum jelly, cold cream, or hand lotion rubbed into the skin after washing may help to prevent chapping and to keep the skin in good condition.

Adequate sleep is necessary for the health, well-being, and efficiency of the individual. Sleep requirements may vary considerably, and the sleeping habits of crew members may be quite dissimilar. However, unbroken periods of rest for everyone are desirable.

Hair should be shampooed frequently, cut at regular intervals, and preferably kept short.

Cleanliness aboard ship can be encouraged by providing sufficient hot water in convenient wash places to facilitate cleansing. Installation of a laundry and drying room for washing clothes also helps to maintain a high standard of cleanliness.

Each member of the crew should use only his own towels and be responsible for their cleanliness. Wet towels should not be folded and stowed; dirty towels should be laundered as soon as possible and not allowed to accumulate. Single-use paper towels are satisfactory only if waste receptacles are provided and used.